STATION PAPER No.32

DECEMBER 1949

BINOCULARS WITH MIL SCALE AS A TRAINING AID FOR ESTIMATING FORM CLASS

BY

H.W. CAMP, JR., and C.A. BICKFORD

Northeastern Forest Experiment Station

Upper Darby, Pa.

V.L. Harper, Director

U.S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

CONTENTS

BINOCULARS WITH MIL SCALE AS A TRAINING AID FOR ESTIMATING FORM CLASS

by

H. W. Camp, Jr., forest economist, and
C. A. Bickford, statistician

NORTHEASTERN FOREST EXPERIMENT STATION

In an extensive forest inventory, estimates involving personal judgment cannot be eliminated. However, every means should be taken to keep these estimates to a minimum and to provide on-the-job training that is adequate for obtaining the best estimates possible.

A PROBLEM IN TRAINING

One of the problems in an extensive forest inventory is to train fieldmen in estimating form class accurately. Form class as referred to here is that developed by James W. Girard for use in estimating board-foot volume. It is defined as--

> "The percentage ratio between the diameter, inside bark, at the top of the first 16-foot log and the diameter, outside bark, at breast height ($4\frac{1}{2}$ feet above the ground)." [1]

The training procedure commonly used is fundamentally as follows: First, the fieldmen make estimates of form

[1] Mesavage, Clement, and Girard, James W. Tables for estimating board foot volume of timber. 94 pp. U.S. Forest Service. Washington. 1946.

class by eye, then check their estimates through actual measurements. They measure the diameter at breast height with a diameter tape. Then they climb the tree and measure the diameter at the top of the first 16-foot log with a tape, and bark thickness with a bark-thickness gage. From these measurements, they calculate the form class. They repeat this procedure until they become proficient.

The value of such training is unquestioned. But it is tiring and time-consuming, and often must be repeated when the fieldman goes into a new area where form conditions are different or when lack of practice has dulled his eye.

In an extensive forest inventory the advantage of steady practice as a sort of training is missing. Usually the fieldman must spend time alternately in the field and in the office on photo interpretation or compilation work. This does not permit him to "keep his eye in" for estimating form class.

Also, to reach survey plots, the fieldman usually must travel a considerable distance across rough terrain on foot and it is impractical to burden him with tree-climbing equipment, ladders, or extension calipers. Carrying such a load, a fieldman can easily develop a tendency to rely on estimates by eye, without proper checking. This can result in serious error: it is estimated that an error of one form class represents about 3 percent in board-foot volume. Thus, there is need for a training aid that can be readily used in the field.

A TRAINING AID — BINOCULARS

In our search for a training aid, one possibility that suggested itself was binoculars. Binoculars with mil scales have long been used for military purposes. By using them, artillery and machine-gun crews are able to adjust fire onto a target within a few seconds. The Forest Service has used binoculars for measuring the spread of forest fires. Why could they not also be used for estimating form class? Moreover, they are light, and could easily be carried into the field. They are also useful for other purposes, such as type mapping from high points.

Binoculars were tried out for estimating form class in West Virginia. Results were encouraging. Data were taken for 33 trees representative of common hardwoods found in West Virginia, ranging in diameter at breast height from 11.0 to 21.7 inches. The diameter outside bark at 17.3 feet (16-foot log plus 1-foot stump and 0.3 foot trimming allowance) was measured both with extension calipers and with the mil scale of the binoculars, to the nearest one-tenth inch. Diameters measured with the mil scale agreed closely enough with the calipered measurements to confirm our belief that binoculars could be adapted to measuring tree diameter.[2]

In adapting binoculars with mil scale for use in estimating form class we found it necessary first to select a distance from the 17.3-foot point on the trees from which diameter measurements would always be taken. To calculate this distance we assumed that good visibility of the first log can usually be obtained at 33 feet from the base of the tree. Further, we assumed that the average man's eye is 5.5 feet above the ground. On these two assumptions, the distance to maintain from the eye to the 17.3-foot point on the tree is the hypotenuse of the right triangle so formed, or 35.046 feet. Using 35.046 feet as a basis, we prepared an alinement chart for converting mil-scale units to inches.

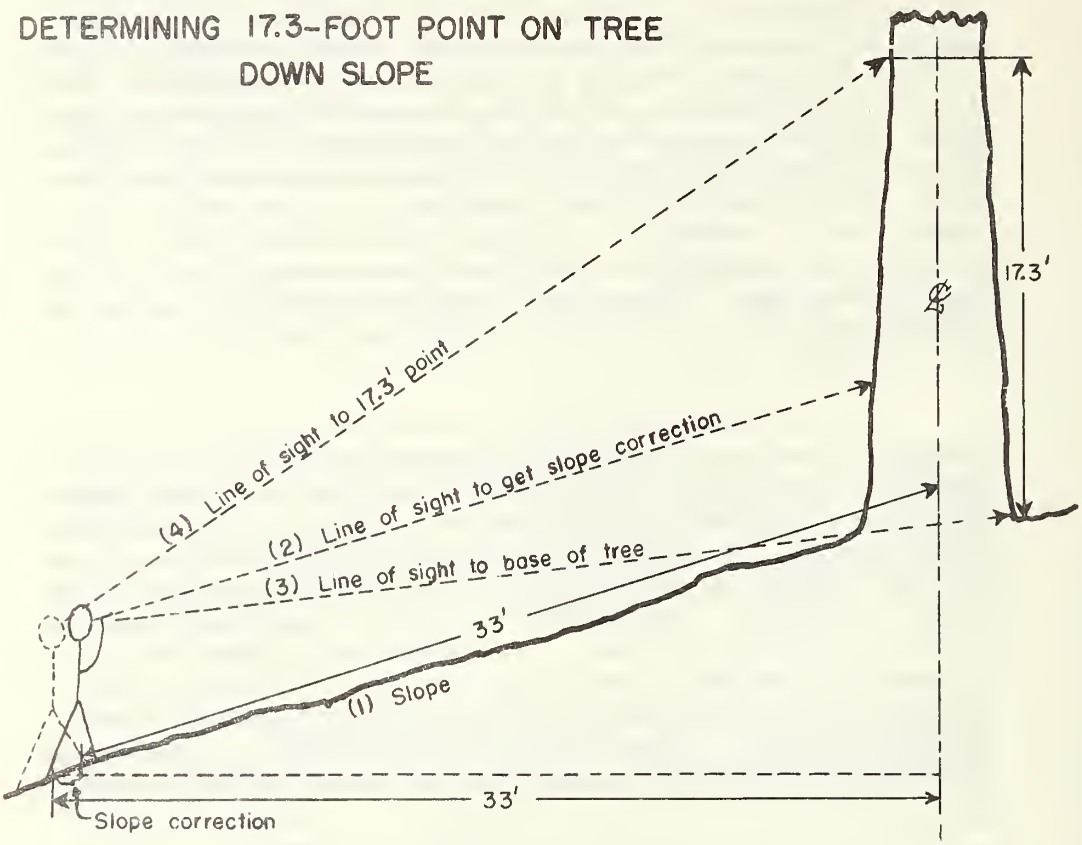
To expedite work in the field, alinement charts were also developed for converting topographic slope units to slope correction in links, and for converting diameter measurements to form class.

USING THE BINOCULARS

Getting into position

To get an accurate measurement with the binoculars, you must first get an observation point the proper distance

[2] STUDENTS' T-TEST WITH PAIRED OBSERVATIONS WAS APPLIED TO THE DISTRIBUTION OF THE DIFFERENCES. THE MEAN DIFFERENCE IS 0.0818 INCHES, WITH CALIPERED DIAMETER GREATER THAN DIAMETER MEASURED WITH THE MIL SCALE. COMPUTED 'T' IS 1.16, WHICH, WITH 32 DEGREES OF FREEDOM, COULD EASILY RESULT FROM PURELY RANDOM VARIATION.



EXAMPLE

Step 1.—Measure 33 feet (1/2 chain) from center of tree.

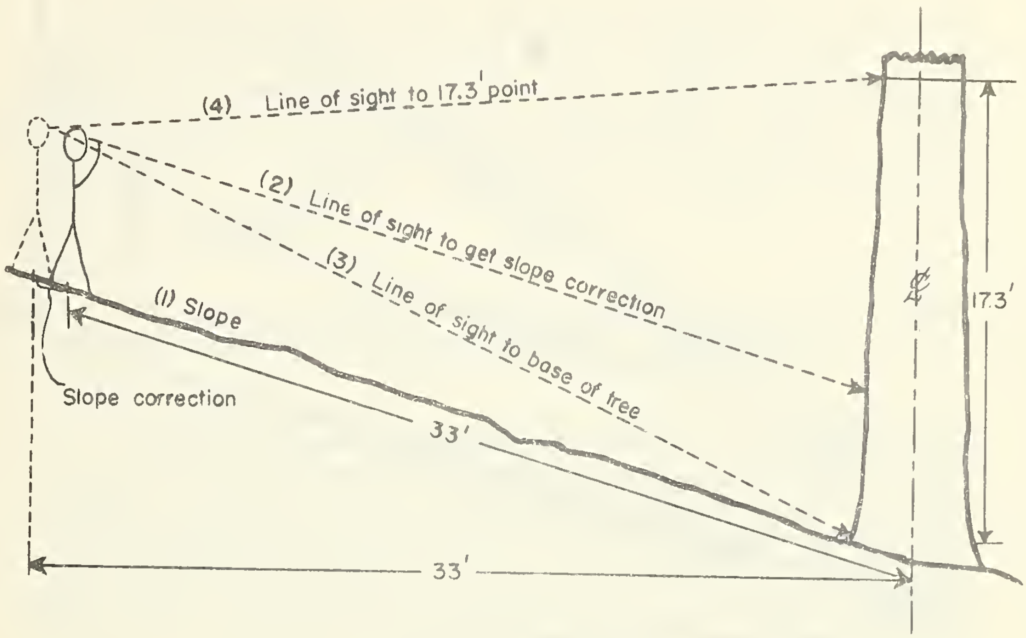
Step 2.—Take Abney level reading to get slope correction. Make slope correction for 1/2 chain as given in standard slope-correction table.

Step 3.—Take Abney level reading from position established in Step 2, to base of tree on high side. In this example the reading is +7.0 topo units for 1 chain.

Step 4.—To get proper Abney level setting for finding 17.3-foot point on tree, multiply 17.3 by 2 and add the reading obtained in Step 3 (+7.0). This equals +41.6 topo units. Use this setting on Abney level and sight the 17.3-foot point on the tree.

FIGURE 1

DETERMINING 17.3-FOOT POINT ON TREE UP SLOPE



EXAMPLE

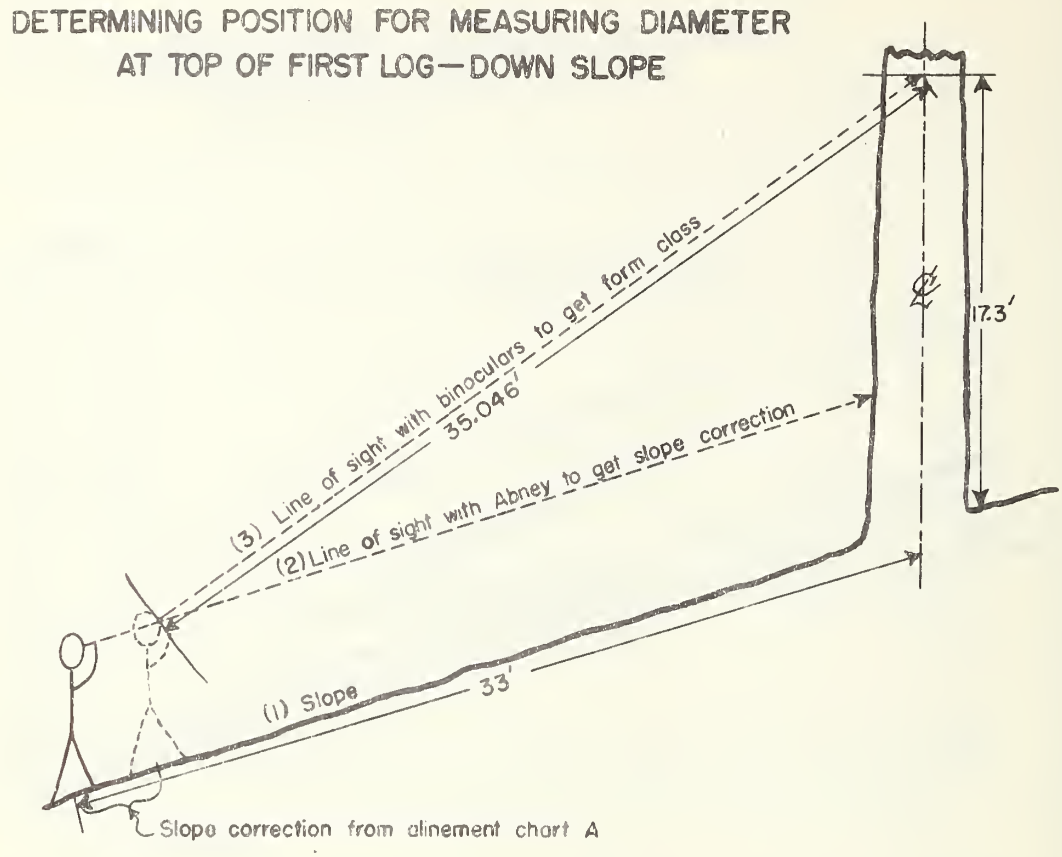
Step 1.—Measure 33 feet (1/2 chain) from center of tree.

Step 2.—Take Abney level reading to get slope correction. Make slope correction for 1/2 chain as given in standard slope-correction table.

Step 3.—Take Abney level reading from position established in Step 2, to base of tree on high side. In this example the reading is -29.4 topo units for 1 chain.

Step 4.—To get proper Abney level setting for finding 17.3-foot point on tree, multiply 17.3 by 2 and subtract the reading obtained in Step 3 (-29.4). This equals +5.2 topo units. Use this setting on Abney level and sight the 17.3-foot point on the tree.

FIGURE 2



EXAMPLE

Step 1.—Measure 33 feet (1/2 chain) from center of tree.

Step 2.—Take Abney level reading to determine slope. When down slope from tree Abney level reading is always minus, and a minus slope correction must be made. In this example the slope reading is –18.4 topo units. Correction, from alinement chart (fig. 5, A), is –5.2 links or –3.4 feet. Take slope correction toward tree. This procedure will maintain 35.046-foot distance from eye to 17.3-foot point on tree.

Step 3.—With binoculars, sight on 17.3-foot point on tree from position determined in Step 2, and read diameter outside bark in mil-scale units.

FIGURE 3

from the tree. First, measure 33 feet out from the center of the tree, on the contour. If you can get a clear view of the first log from this point, use this as your observation point.

But you may have to move up or down the slope from the tree to get a clear view of the first log. If so, select the direction of least slope. Then, using an Abney level, make the proper distance adjustment so your observation point is 33 feet from the center of the tree, on the horizontal. Figures 1 and 2 show the steps to follow in making this adjustment.

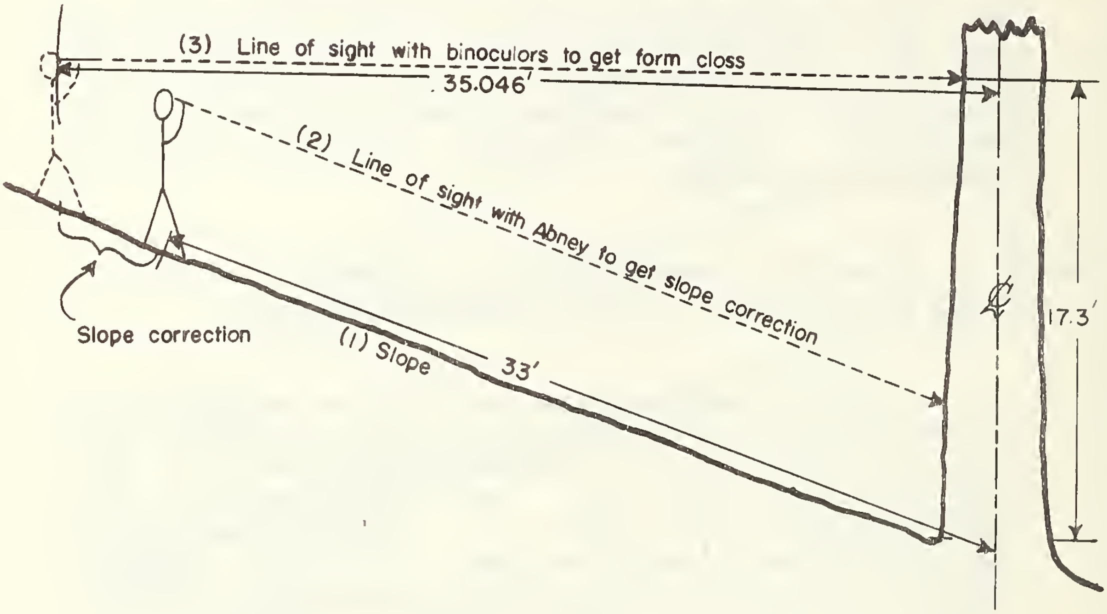
From this observation point, determine the 17.3-foot point on the tree, preferably with an Abney level.

Next you must determine the point on the ground that is 35.046 feet from the 17.3-foot point on the tree. To do this, go back to the first point you measured 33 feet from the center of the tree. Make a new slope correction, using alinement chart A (fig. 5). This will tell you how many links to move toward the tree (if you are downhill from it) or away from the tree (if you are uphill). Figures 3 and 4 illustrate the steps to follow. This new slope correction may differ both in distance and direction from the first slope correction you made.

Measuring the tree with mil scale

From this new position, sight the binoculars on the 17.3-foot point and take a mil-scale reading of the diameter outside bark, estimating to the nearest whole unit. You must focus the binoculars carefully on the <u>tree</u>, rather than on the mil scale; otherwise considerable error will be introduced in the mil-scale reading. Because of the magnification in the binoculars, movement of the instrument will cause considerable variation in the readings. With practice you can develop a steady hand and reduce this difficulty to a minimum.

DETERMINING POSITION FOR MEASURING DIAMETER AT TOP OF FIRST LOG—UP SLOPE



EXAMPLE

Step 1.—Measure 33 feet (1/2 chain) from center of tree.

Step 2.—Take Abney level reading to determine slope. When up slope from tree Abney level reading is always plus, and a plus slope correction must be made. In this example the slope reading is +22.4 topo units. Correction, from alinement chart (fig. 5, A), is +5.7 links or +3.8 feet. Take slope correction away from tree. This procedure will maintain 35.046-foot distance from eye to 17.3-foot point on tree.

Step 3.—With binoculars, sight on 17.3-foot point on tree from position determined in Step 2, and read diameter outside bark in mil-scale units.

FIGURE 4

Use of alinement charts

After making the mil-scale reading, convert it to inches, using alinement chart B (fig. 5), and estimate deduction for bark thickness at the top of the first log. Knowing the outside-bark diameter of the tree at breast height and the diameter inside bark at 17.3 feet, you can convert directly to Girard form class by using alinement chart C (fig. 5).

PRACTICAL APPLICATION

Use of binoculars with mil scale is not a panacea for problems in estimating form class. Rather, it is proposed as a useful aid for training men who are not constantly engaged in estimating form class, so they can become more accurate and more consistent in their estimates. For such training to be of the most value, the men being trained should first make and record their ocular estimates, then compare these estimates with the form class they determined with the binoculars.

AGRICULTURE -- FOREST SERVICE -- UPPER DARBY

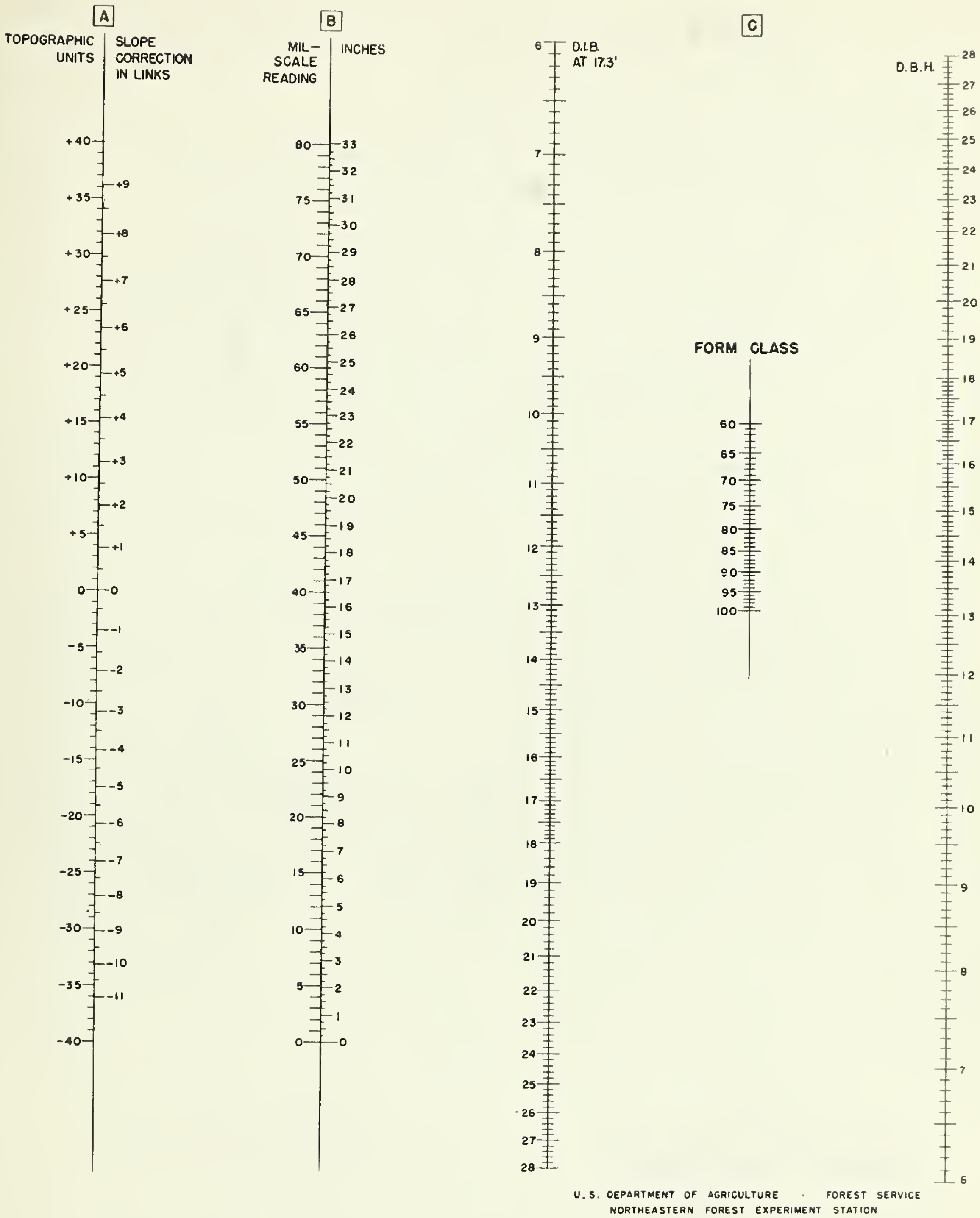
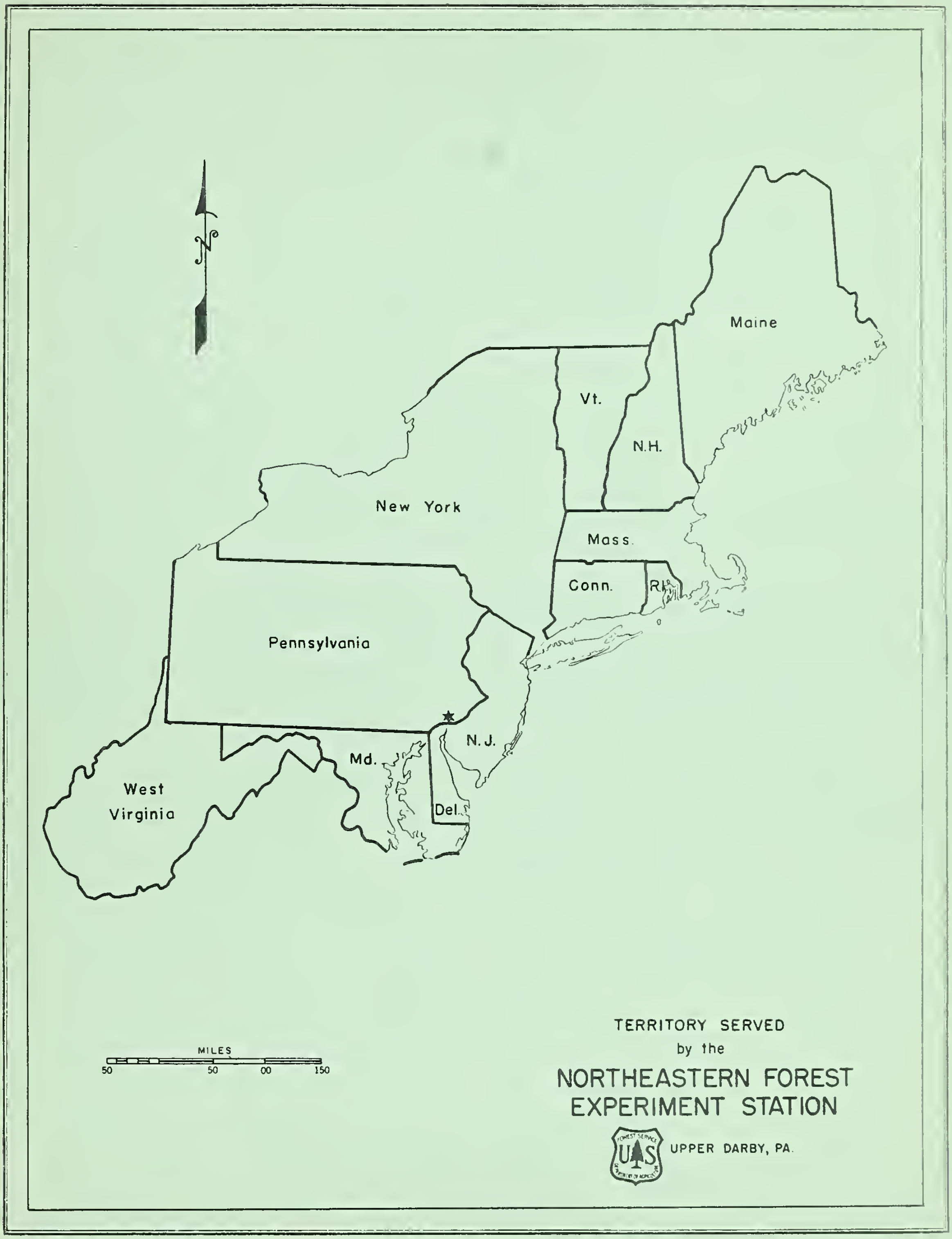


FIGURE 5.—Alinement charts used in estimating form class with the aid of mil-scale binoculars.


N
Maine
Vt.
N.H.
New York
Mass.
Conn.
R.I.
Pennsylvania
N.J.
Md.
Del.
West Virginia
MILES
TERRITORY SERVED
by the
NORTHEASTERN FOREST
EXPERIMENT STATION
UPPER DARBY, PA.